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A TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR DESIGNED TO IMPROVE FUNCTIONAL RESULTS BY IMMEDIATE REDUCTION OF DEFORMITY AND BY EFFECTIVE PROTECTION DURING THE PERIOD OF REPAIR.[1]

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Fracture of the neck of the femur, the most disabling of all fractures, is generally regarded with an apathy which is suggestive of neglect.

According to one of the older writers: "Our prognosis in cases of fracture of the neck of the femur must always be unfavorable. In many instances the injury soon proves fatal, and in all the functions of the limb are forever impaired." (Robert Smith, quoted by Hamilton.) And one of the recent investigators sums up the patient's prospects as follows: "If he escapes with his life he has to be contented with loss of function, loss of symmetry and equipoise, and is often obliged to go about permanently crippled." (Bissell, *Philadelphia Medical Journal,* May 30, 1903.) These quotations express the general impression that the patients are, as a rule, aged and feeble, that treatment is hazardous and that in any event, it is likely to be of little avail, because of the weakness of the reparative processes in the injured part.

The popular misapprehension that classes this fracture as an almost exclusive attribute of old age, and which has for generations obscured diagnosis and hampered treatment, may be explained doubtless by the fact that it is far more common in old age than at any other period of life. But, on the other hand, the fracture is far from uncommon at any age, even in childhood, and it may occur in middle life not only as the direct result of violence, but under the same slight provocation as in the aged.

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[1] Read before the New York Academy of Medicine, April 6, 1905.

Even in Hamilton's statistics of Bellevue Hospital, although compiled at a time when fracture of the neck of the femur in childhood was unheard of, and when as at present the injury in young adults was generally overlooked, or at least was not represented in the hospital wards, it may be noted that but 37 per cent. of the patients were more than sixty years of age.

One hears constantly of the danger of this accident or more particularly of the danger of treatment, yet the latest statistics of the same unfavorable class indicate that the danger has been greatly exaggerated. Thus in 241 cases treated in three consecutive years in Bellevue Hospital there were but three deaths, one within twenty-four hours of admission and two from alcoholism and nephritis (Bissell, *loc. cit.*).

I have, for the sake of argument, classed sixty years as old age, an age that might serve as a legitimate excuse for non-treatment, even though the decision condemned the individual to lifelong disability; but as patients much younger are so often told that they are too old to be benefited by treatment, it may be assumed that it is not so much the prospective danger of treatment as the belief in its futility that prevents its application.

This brings the discussion to the real point at issue, which is not the relative number of patients who for one reason or another must remain untreated, but how may one explain the failures in those cases in which treatment has been applied. Are they due to anatomical peculiarities of the injured part that make it an exception among fractures, or is the treatment exceptionally inefficient in accomplishing its object, that object being the reduction of deformity and the subsequent fixation of the fragments?

The first question can only be the subject of conjecture, and granting that for one reason or another the reparative power is more feeble here than elsewhere, it follows that accurate adjustment is the more essential.

The second question, whether the treatment is so conducted as to deserve success admits of demonstration, and for this one turns naturally to the hospitals, where surgeons are trained and where students are taught, for the standard that regulates treatment under less favorable conditions.

The typical treatment is the application of the long side T-splint to which the body and limb are bandaged, together with a traction weight of perhaps ten pounds. The lateral splint, in the absence of anteroposterior support, cannot fix the fragments, nor is the traction force, acting against gravity and the friction of the splint, sufficient ordinarily to reduce or to control the deformity.

If the fracture is near the shaft, repair is possible, but if the small part of the neck is broken, apposition is essential, and shortening of an inch or more, as is often present when the apparatus is removed, is a sufficient explanation of non-union.

In some instances the Hodgen suspension and traction is employed or traction alone, but the principle is essentially the same. In the treatment of less important fractures, accurate adjustment of the fragments is the essential, to which the character of the support is subordinated, in this instance one is usually content to apply apparatus and let the fragments adjust themselves. For this automatic adjustment one depends upon traction, which is usually inefficient if it is light, and uncomfortable and difficult to maintain if it is heavy. It is a treatment, therefore, which to be effective requires far more supervision than a hospital patient is likely to receive.

It may be noted also that the treatment of this injury is practically controlled by house officers, who, with no previous experience or opportunity to observe results, must follow the accepted teaching. Finally, the indifference to the future of a patient that allows the abandonment of treatment after a few days or a few weeks is further evidence of the prevailing impression as to its futility.

These facts are of importance in estimating the value of the final results of hospital practice as influencing prognosis in general. For it may well be that treatment is perfunctory because the prognosis is bad, and the prognosis is bad because the treatment is ineffective.

Thus far, complete fracture has been considered. The impacted or incomplete fracture, a variety that occurs particularly in young subjects, is so often overlooked that its frequency is by no means appreciated. The accepted teaching is, that no attempt should be made to reduce the deformity, because non-union is so common after complete fracture. This teaching disregards or ignores the fact that this deformity almost always entails disability. There is, for example, limitation of motion, with an especial tendency toward flexion and adduction that often adds an apparent to the actual shortening of the limb. There is, too, in most cases, persistent discomfort on overuse or whenever the contracted muscles or other tissues are strained by unguarded movements. The function of the joint is often further impaired by exuberant callus formation or other nutritive disturbance at the seat of injury, caused indirectly, at least, by the unreduced deformity.

It is of course admitted that the treatment of fracture of the neck of the femur, aside even from the physical limitations of so many of the patients, is most difficult, since the fracture involves a joint, and since direct adjustment of the fragments is impossible, to say nothing of the distorting and crushing effects of the original violence. It seems to me, however, that these difficulties have been overestimated, especially in view of the fact that it is not restoration of function, but merely union, that is the present standard of success.

I think myself fortunate in having been led to a consideration of this subject from a more normal standpoint, namely, by recognizing the fracture in childhood, a period that offers the most favorable opportunity for treatment, and for the observation of final results. This opportunity illustrated the dependence of normal function upon normal form, and the importance of remedying deformity whenever possible. My interest was still further stimulated by the observation of numbers of adults, crippled in vigorous life, who sought relief from persistent discomfort. Many of these patients had received no treatment whatever, and in other instances the method and manner of treatment sufficiently explained its failure.

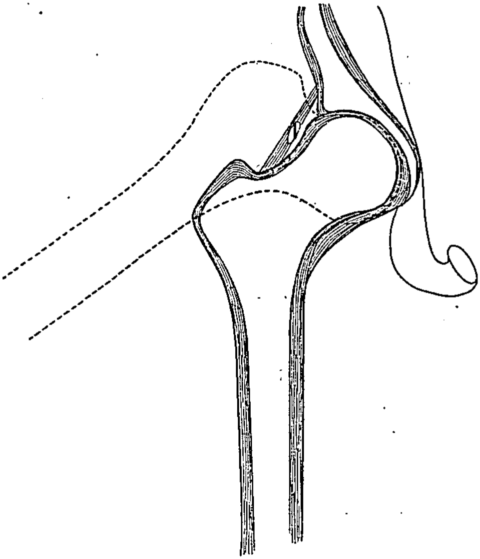
I speak of a more normal standpoint, for admitting it to be a fact that age or weakness may, in a large proportion of cases, make treatment impracticable, we may at once dismiss these cases from consideration. The practical question is this, What treatment, applied under favorable conditions, will best assure reduction of deformity and the retention of the fragments for a sufficient time to permit union. In other words, one should consider the treatment of fracture of the neck of the femur primarily from the mechanical standpoint, and then he may take into account the modifications that age or weakness or other circumstances may necessitate.

Proceeding thus, as it were, along the lines of least resistance, we may consider first the treatment of the incomplete or impacted fracture. In childhood this is usually simple depression of the neck (traumatic coxa vara). In adult life there is more often a true impaction, the neck of the bone being actually driven into the shaft.

I have spoken of the dependence of normal function upon normal form as a reason for disregarding the present teaching, that an impaction should not be disturbed. To illustrate; the range of normal abduction at the hip, which depends upon the upward inclination of the femoral neck, is checked primarily by the resistance of the opposing muscles and by tension on the capsule, but ultimately by the direct contact of the outer part of the neck with the upper border of the acetabulum (Fig. 1). It follows, then, that if the upward inclination is lessened or lost as the result of injury, the range of abduction must be proportionately decreased by the abnormal bony contact (Fig. 2).

The complete range of abduction which under normal conditions is still further restricted by muscular control is, after fracture of the neck of the femur, even more limited by the latter agency, for there is usually an accommodative shortening of the muscles during the process of repair which is often exaggerated by the spasmodic contractions that are usually present whenever function causes pain. This restriction of abduction is in itself a cause of disability. Furthermore, it may be assumed that in adult life, as in childhood, the original depression of the neck of the femur, by subjecting it to increased strain, leads in many instances to greater disability when function is resumed, because complete repair must be long delayed. It seems probable, also, as has been mentioned, that the exaggerated callus formation and the so-called rheumatoid changes, illustrated by museum specimens, may be explained, in part at least, by unreduced deformity and by the disturbance of function that results. At all events, the advantage of correcting deformity should be apparent.

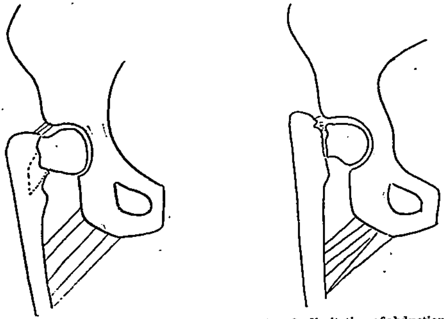
FIG. 1



Section of a hip-joint. The dotted outline illustrates limitation of the range of normal abduction by contact of the outer border of the neck with the upper border of the acetabulum and of the trochanter with the tissues covering the side of the pelvis. (Fick.)

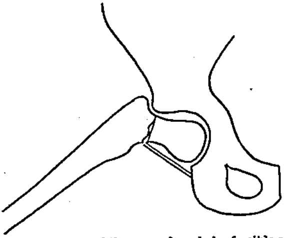
In cases of impacted fracture, as has been pointed out, abduction of the thigh is checked by accommodative muscular contraction within the range that the deformity permits; but when this is overcome it is limited by contact of the deformed neck with the upper border of the acetabulum (Figs. 2 and 3). If then the patient be anæsthetized, one may, by means of the leverage of the extended limb and the fulcrum formed by the upper border of the acetabulum, overcome this restriction by forcible abduction, which must then straighten or elevate the neck, provided complete consolidation has not taken place. For the weakened bone must give way before the head, firmly held by the cotyloid ligament, can be dislocated. Traction on the limb and downward pressure on the projecting trochanter during the manœuvre may still further aid in restoring normal contour. If the limb is fixed in this attitude of normal abduction there should be no danger of non-union, but repair should proceed in a more normal manner than if the deformity were allowed to persist, for the reasons already mentioned (Figs. 4

FIG. 2 FIG. 3



Impacted fracture of the neck of the femur, illustrating the limitation of abduction caused by the deformity.

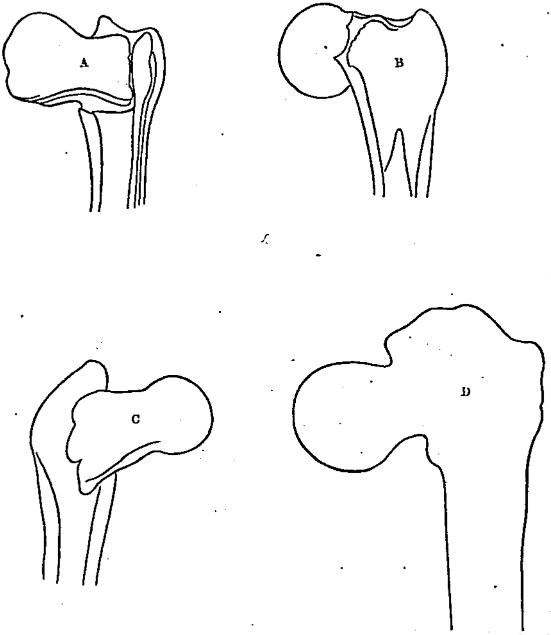
FIG. 4



Illustrates the restoration of the normal angle by forcible abduction.

and 5). It may be noted also, as has been demonstrated by x-ray pictures (*Pels-Leusden, Archiv f. klin. Chir.* vol. lxvi.) that in a certain proportion of the cases passing for fracture of the neck of the femur the injury is a fissure or other distortion in the neighborhood of the trochanters, permitting depression of the neck (Fig. 6). For cases of this class, which may include subtrochanteric fractures also (Fig. 7), forcible abduction and direct traction under anæsthesia should be equally efficacious in restoring the proper relations.

Fig. 5



Specimens illustrating the deformity of incomplete fractures which might have been reduced or lessened by abduction: A, Stimson; B, Kœnig; C, Bergmann; D, Kœnig.

It is of course evident that while one might perfectly restore the normal contour by this method if the neck were simply depressed, as is usual in childhood, one could not hope for this if the deformity were complicated by splintering of the shaft or extensive crushing of the neck of the bone. He could hardly fail, however, to improve the local condition, and at all events the fixation of the limb in the abducted position would surely prevent the adductor contraction which is so often present in these cases even before the limb is used

As the reduction of deformity of incomplete fracture is quite opposed to accepted teaching, it should be stated that it is the method of reduction and fixation that makes it feasible. The disadvantages of deformity have been indicated, the only possible advantage of impaction being fixation. This method, which makes it possible to reduce the deformity without separating the fragments, is conducted somewhat as follows:

FIG. 7

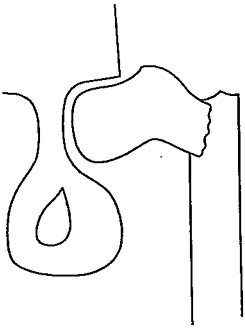


FIG. 6

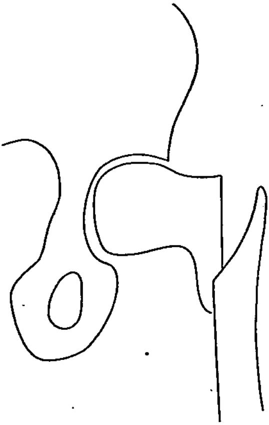
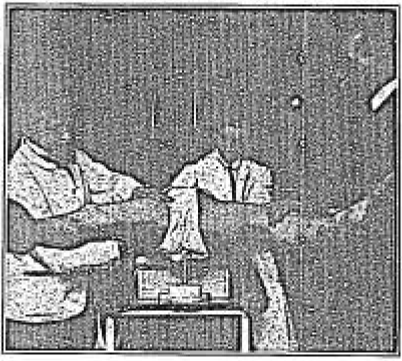


FIG. 6.—Fissure which might be closed by abduction.
FIG. 7.—Fracture at the base of the trochanters. Abduction of the thigh under traction would place the two fragments in proper relation.

The patient having been anæsthetized is placed upon a box about seven inches in height and of sufficient size to support the trunk. The pelvis rests upon the sacral support of the Lorenz model and the extended limbs are held by assistants. That on the fractured side is gently abducted until the abnormal resistance is encountered, then under traction, the joint being supported by the hands of the operator, the limb is slowly abducted to the normal limit (about 45 degrees). The pelvis meanwhile is prevented from tilting upward under the pressure by simultaneously abducting the sound limb to the same degree. Thus it may serve to illustrate approximately the angle at which its fellow should be fixed. In this attitude the plaster support is applied in a manner to be described (Fig. 8).

Not only should care be exercised in reducing the deformity, but in the selection of cases also, since one would hardly be justified in performing the operation unless he were assured that the subsequent support could be properly applied and used. For it is because the application of the support is a continuation of the process of reduction that this method of treatment is not likely to endanger the result.

FIG. 8



Impacted fracture of the neck of the right femur, illustrating the reduction of the deformity by direct traction and abduction. The operator supports the joint. The left limb is abducted to indicate the normal range, which varies in different subjects, and to prevent tilting of the pelvis.

If the fracture is complete, the same method may be employed to appose the fragments. In the so-called intracapsular fracture the shortening and outward rotation of the limb may be explained by upward and outward displacement of the proximal fragment of the neck (Fig. 9). To reduce the distortion, therefore, the patient being under the influence of an anæsthetic and in the position already described, one would first flex the thigh somewhat.

This flexion might serve also, as Maxwell has suggested, to disengage the iliopsoas muscle if it were interposed between the fragments. The outward rotation is then corrected and finally the limb is drawn down by direct traction to its normal length, as proved by measurement, and abducted in the manner described, downward and inward pressure being exerted meanwhile upon the trochanter. If sufficient of the proximal fragment of the neck remains, as in intracapsular fracture, it may be forced beneath the rim of the acetabulum. Or if the fracture is at the base of the neck, upward displacement is prevented by direct contact of the trochanter with the side of the pelvis (Fig. 10).

The attitude of complete abduction has several advantages in the treatment of this fracture. It exercises direct traction upon the capsule; thus it should disengage folds of ligament or muscle that may be interposed between the fragments, and as the capsule is attached about the cotyloid cartilage tension upon it should serve to correct malposition of the inner fragment and to bring the two into contact.

FIG. 9

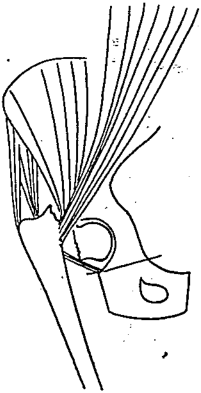


FIG. 10

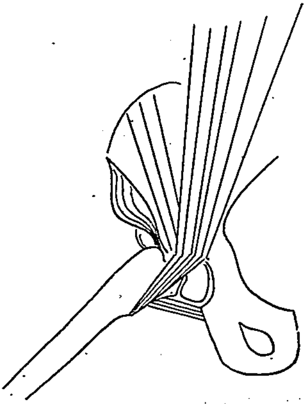


FIG. 9.—Complete fracture of the neck of the femur, illustrating the influence of the muscles in increasing the displacement.

FIG. 10.—Complete fracture, after reduction and fixation in the position of abduction, illustrating the security assured by the direct contact of the trochanter with the side of the pelvis; also the tension on the capsule and the removal of the deforming influence of the muscles.

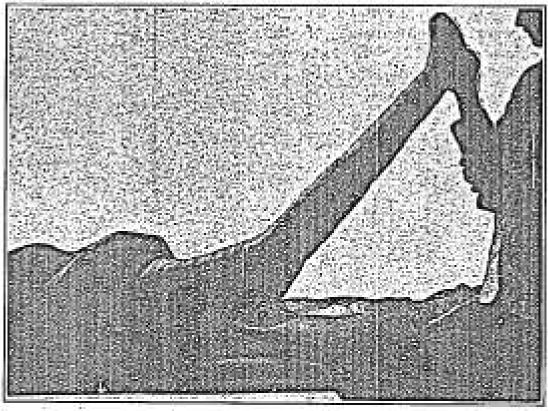
Abduction must also relax the abductor group of pelvitrochanteric muscles, and it so changes the direction of the iliopsoas muscle that its contraction, instead of inducing deformity, would tend rather to appose the fragments (Fig. 10).

It would appear that in complete fracture there is a tendency for the thigh, occupying a higher position than the trunk, to sink downward, thus displacing the proximal behind the inner fragment.

When, therefore, by abduction one aims to fix the part by pressing the trochanter against the soft tissues covering the side of the pelvis, he should assure himself that it occupies its normal position with relation to the acetabulum, and it may be well to press the upper part of the thigh forward, with the aim of forcing the fragments against the tense anterior wall of the capsule. This position is then at once assured by the plaster bandage.

It may be noted, then, that in the treatment of the impacted fracture passive abduction serves primarily as a means, and, as it would appear, the only practicable means, of reducing deformity without danger of separating the fragments. While in the treatment of complete fracture the attitude is employed for the purpose of adjusting the fragments and assuring fixation.

FIG. 11



The long spica as applied for the treatment of fracture of the neck of the femur in the adult at an angle of abduction of 45 degrees.

In both instances the limb must be supported in this attitude during the period of repair.

In the treatment of children and young adults, I have usually employed the long spica, extending from the mammary line to the toes, but in the treatment of older subjects it is of advantage to use a less comprehensive support if it can be made equally reliable, and in more recent cases I have usually applied it to embrace the pelvis only, leaving the upper part of the trunk free in order to permit the semireclining posture (Fig. 11). This form of support is a slight modification of that introduced by Lorenz. It must be closely fitted about the pelvis, particularly above the trochanter and behind the articulation, and great care must be taken that this posterior surface shall be unyielding in order that it may support the broken bone. It must be wide enough also to completely cover and enclose the buttock (Fig. 12). If there is a tendency to upward displacement of the opposite side of the pelvic part of the support, it may be prevented by a wide, firm, perineal band attached to buckles hooked over the front and back of the support, or otherwise attached to it, so that the band passing between the limbs diverges to cover the tuberosity of the ischium (Fig. 13). In some instances, for example, if the limb is swollen, the foot must be included in the bandage. This of course fixes it and absolutely prevents rotation. If, however, the bandage is closely moulded about the patella and condyles of the femur, it need not be extended below the bulge of the calf. In the treatment of complete fracture in fat subjects when rapid atrophy may be expected, and as an additional precaution in other instances particularly when the limb is placed

FIG. 12

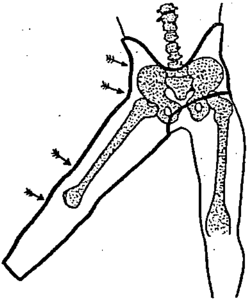


FIG. 13

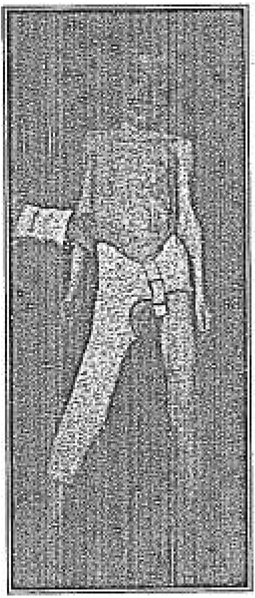


FIG. 12.—The short spica applied to fix the limb in the abducted position, showing the method of moulding it about the pelvis and knee to assure fixation.

FIG. 13.—The short (Lorenz) spica, illustrating the perineal band which prevents movement of the pelvic portion of the support.

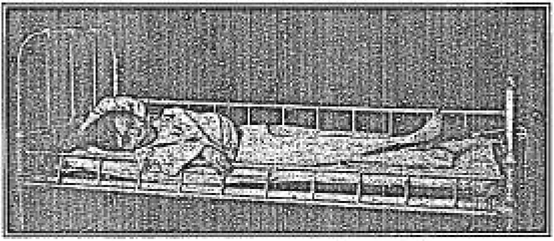
in less than the limit of abduction, the adhesive-plaster traction straps may be applied (Fig. 14).

If the shortening has been completely reduced a traction weight of ten pounds or even less should be ample to prevent displacement, even if the support permitted it.

It is, of course, a great advantage to employ anæsthesia, which indeed is essential for the reduction of the deformity of impacted fracture; but in many instances, particularly in older subjects, it may be advisable to dispense with it. In this event, although the shortening may be reduced by traction and countertraction, it will be hardly possible to place the limb in extreme abduction, traction should be applied therefore as an additional safeguard.

If this form of support is used, the greater part of the back is exposed for inspection and, as has been stated, the patient may be placed in a semireclining posture, and he may be turned from side to side or lifted without pain and without danger of displacing the fragments.

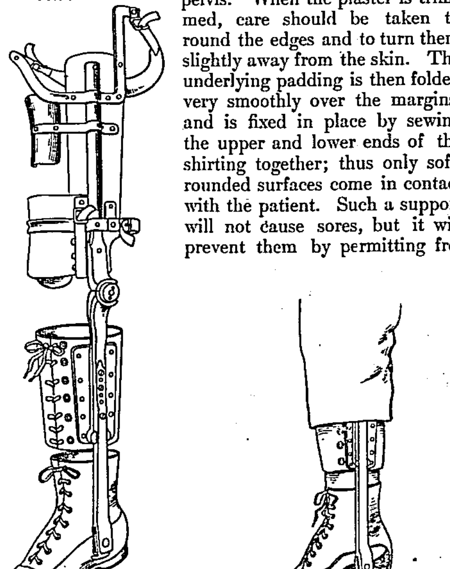
FIG. 14



The short plaster spica, combined with traction.

I have in this argument particularly in mind the favorable cases in which there can be no question as to the advisability of treatment, but in a large proportion of the other cases treatment is not applied because it is thought to add to the danger of the injury. Personally, I should be inclined to attempt treatment in this class, even if there were little hope of union, for the purpose of relieving pain and lessening danger. For fracture at the hip is usually accompanied by local sensitiveness, and often by muscular spasm and the "starting pains" that prevent sleep and weaken the vital resistance. It may be suggested that a plaster bandage is an uncomfortable appliance, but this I cannot admit, for if fixation is essential no other apparatus provides such general and equable support. If a plaster bandage is uncomfortable, it is due to constriction or to wrinkles or to direct pressure on bony prominences, or to the friction of its margins on unprotected surfaces, all of which may be avoided by care in its application. A skin-fitting covering of seamless shirting with its friction bandages is first drawn over the body and limb, and all bony prominences are carefully protected by coverings of double-faced canton flannel, applied firmly and smoothly in one or more thicknesses about the limb and pelvis. When the plaster is trimmed, care should be taken to round the edges and to turn them slightly away from the skin. The underlying padding is then folded very smoothly over the margins, and is fixed in place by sewing the upper and lower ends of the shirting together; thus only soft, rounded surfaces come in contact with the patient. Such a support will not cause sores, but it will prevent them by permitting frequent changes of position and thus of pressure. At all events, it seems more reasonable to apply support with the purpose of discarding it if necessary than to abandon treatment altogether.

Fig. 15



A type of brace that may be used with advantage in the after-treatment of fracture of the neck of the femur. (Taylor.)

In ordinary cases the plaster bandage is retained for about eight weeks, when it may be removed to permit massage and active and passive movement. But as consolidation is apparently long delayed, and as the position of the neck of the femur subjects it to greater strain than falls on any other bone, full function should not be permitted for many months. Crutches may be used, of course, but the best and most convenient support, and one that allows the early resumption of motion and weight-bearing, is a form of convalescent hip splint after the Taylor pattern. This is jointed at the knee and it allows the patient to sit with comfort. It is fixed to the shoe and sufficient weight is borne upon the perineal band to prevent the heel from reaching the sole, thus the foot serves rather as a guide than as a weight supporter. If the brace has been properly adjusted, the patient may walk with but a slight limp, and as strength increases the support is lessened until full function is resumed (Fig. 15). Meanwhile the strength of the muscles is increased by graduated exercises and by gently passive movements directed especially toward abduction, the movement that is oftenest limited. A bicycle placed in a standard is one of the best means for restoring function, the sound limb making the exercise passive until the weakened member has gained sufficient strength to do the work.

It can hardly be claimed that any treatment will always assure union, yet union is essential for the secure support that is necessary in locomotion. If then the treatment outlined has failed, the parts, in the absence of shortening and of swelling and accustomed to the constraint of support, are in the best condition for the open operation, which should logically follow in selected cases.

These conditions are certainly not present in ordinary cases which are presented for operation, for in many instances the shortening is so great that it can hardly be overcome even by long-continued traction in bed; while the secondary changes have so distorted the bones as to make apposition difficult or impracticable.

The joint may be most conveniently opened by an anterolateral incision on the outer side of the tensor vaginæ femoris muscle. The capsule, which is immediately laid bare, is then incised in the line of the neck, or more widely if necessary to thoroughly expose the fragments. In cases of long standing these are, as has been stated, usually worn away and covered with fibrous tissue, which it is difficult to remove; but if the patient had been treated in the manner described, and if the operation were performed within a few months after the injury, satisfactory approximation of the fragments should be easy. A long, sharp drill may then be pushed through the trochanter and the neck into the inner fragment, the outer end being driven beneath the skin to guard against infection. Large nails sometimes used for this purpose require more extensive operations for insertion and it is doubtful if they are often necessary or effective as a permanent support, for the bone in my experience is abnormally soft and, as is well known, it usually recedes from about a foreign body.

The advantage of the abducted position in apposing the fragments is demonstrable and the limb is fixed therefore at the proper angle by a plaster bandage. The after-treatment is the same as in non-operative cases. The drill may be removed through a small incision, or left in position, if this seems desirable.

Under the conditions described this operation should not be dangerous. Infection, that so often occurs in cases of this character, is favored by violent and prolonged manipulation required by the resistant contractions of the tissues. The fact that union often takes place when the fragments are approximated even long after the original injury shows very clearly that the failure of primary union might be explained by ineffective treatment.

As has been stated, the cases now presented for this operation, because of muscular contractions and local changes at the seat of injury, are of an unfavorable class, and in certain instances it may be impossible to appose the fragments.

In such cases, in view of the fact that secure support is far more important than motion, one should not be content to remove the useless fragment, but should attempt to secure union between the upper extremity of the femur and the side of the pelvis. For this purpose one must cut away sufficient bone from the upper margin of the acetabulum and from the inner surface of the trochanter to allow accurate apposition when the limb is extended and slightly abducted. Fixation is then assured by the insertion of a nail or drill in the manner described.

In the large class now coming under observation in which treatment has been ineffective and in which the open operation is contraindicated, there are cases of extreme disability and discomfort, and in certain of these one may follow the suggestion of Lorenz with advantage, namely, to force the upper extremity of the femur from the dorsum of the ilium to a position in front of the acetabulum, with the aim of lessening deformity and assuring a more secure support in locomotion. This position of overextension and moderate abduction must be retained for many months by the use of a short spica plaster bandage. In other cases of this class, in which force is contraindicated, discomfort may be relieved in great degree by the application of a pelvic support that provides even a slight degree of lateral pressure and fixation. For example, a canvas spica carefully fitted to the pelvis and thigh, stiffened with whalebone, with the addition of a wide pelvic strap so that lateral pressure may be adjusted by the patient.

Attention may be called at this point to the fact that in young subjects there are two distinct forms of fracture of the upper extremity of the femur. True fracture in which the neck is depressed as a whole, and partial epiphyseal disjunction in which the injury involves its articulating extremity.

Distortion of the neck of the femur in a healthy child due to direct violence is usually of the green-stick variety (traumatic coxa vara). (Fig. 3). The symptoms, therefore, when the immediate reaction to the injury has subsided, are similar to those of the impacted fracture in adult life except that as there is rarely actual crushing, the trochanter is more prominent and the symptoms less disabling.

Epiphyseal disjunction usually occurs in adolescence, particularly in youths of the fat or overgrown type. The symptoms are gradual in onset, resembling those of ordinary coxa vara, and the injury that induces them may have been of the slightest description. The physical signs, namely, shortening and outward rotation of the limb, are accompanied as a rule by far greater limitation of motion than in fracture of the neck of the femur. This is readily explained by the situation of the injury, which directly involves the articulation. Thus, in ordinary fracture of the neck the symptoms follow injury; they are immediately disabling and lessen as repair advances. In epiphyseal injury the symptoms gradually increase as the head of the bone is slowly forced downward and backward by functional use (Figs. 16 and 17).

FIG. 16

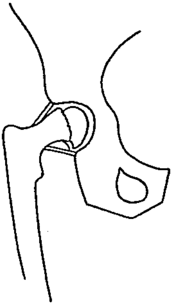


FIG. 17

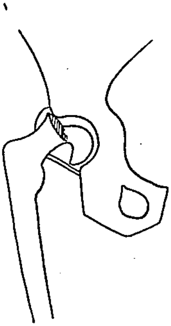


FIG. 18

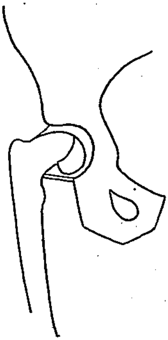


FIG. 16.—Partial epiphyseal fracture; slight displacement of the head backward and downward.

FIG. 17.—Advanced epiphyseal displacement.

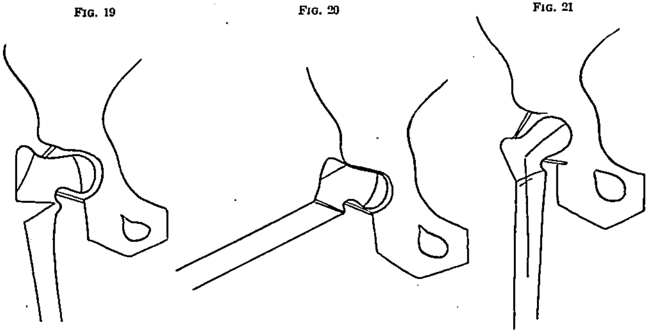
FIG. 18.—Epiphyseal coxa vara.

In the treatment of the first class forcible abduction is especially efficacious, but in the second class, in which the injury involves the articulating extremity of the femur, the procedure could hardly be effective and the open operation is indicated.

If on investigation the displacement is slight, one may content one's self with removing the projecting upper and inner extremity of the neck which directly impinges on the border of the acetabulum and thus checks the range of abduction and flexion. In most instances, however, one should attempt to replace the head in its normal position. In this procedure, the head is first completely separated from the neck by means of a thin chisel, and as it is pressed forward, reposition is effected by forcibly abducting and rotating the limb inward. Protection must, of course, be assured until union is firm. Complete direct epiphyseal separation is very uncommon. If the diagnosis were made immediately it is probable that the deformity might be reduced by abduction and downward pressure on the trochanter. It may be noted here that the gradual and incomplete epiphyseal displacement resembles very closely a form of coxa vara in which the deformity is principally in the newly formed bone near the head of the femur. In the traumatic form the symptoms are, as a rule, more severe and date more or less directly from a definite, if slight, injury. In any event the treatment might be applied to both varieties, although the prognosis would be better in the traumatic form (Fig. 18).

As an indication of relative frequency of the two forms of injury, I may state that of 34 cases of fracture of the neck of the femur in young subjects that have come under my observation, in 8 the injury was apparently at or near the epiphyseal junction, while in 26 it was outside this point.

FIG. 19 FIG. 20 FIG. 21



FIGS 19, 20, and 21 illustrate the treatment of fracture of the neck of the femur after consolidation by restoration of the normal angle.

FIG. 19.—A wedge is removed from the base of the trochanter.

FIG. 20.—The limb is then gently abducted until the motion is checked by contact of the neck and the upper border of the acetabulum. Further abduction closes the wedge-shaped opening, and the limb is fixed in the abducted attitude.

FIG. 21.—When the limb is brought to the median line the normal angle is restored.

In many instances patients of the latter class do not come under observation until repair is complete, when the principal symptom is a persistent limp. At this time forcible abduction could hardly accomplish its purpose, but the normal elevation of the neck may be restored indirectly. Thus a sufficient wedge of bone is removed from a point directly opposite the trochanter minor, leaving a thin shell of cortex on the inner side. The limb is gently abducted until the neck impinging on the acetabulum becomes fixed, when further abduction closes the wedge-shaped opening at the limit of normal abduction. The wound is closed and the limb is fixed in this attitude until repair is complete. When it is replaced in normal position the angle of the neck is restored (Figs. 19, 20, and 21).

This operation I have performed many times for the relief of the simple as well as the traumatic coxa vara, and thus far with success.

As greater distortion, and particularly shortening of the neck, is usually present in the impacted fracture of adult age, this operation could hardly be as successfully applied as in younger subjects. If, however, as in certain cases of this class, the limb is adducted, or if motion is unnecessarily limited by secondary muscular contraction, the more troublesome symptoms can be relieved by abducting the limb under anæsthesia to the degree that the deformity of the bone permits, and fixing it for a time by means of a plaster bandage. The improvement in attitude may be assured by subsequent manipulation, massage, and appropriate exercises.

In this brief summary of what may be termed positive, as contrasted with negative, treatment I have not cited cases to illustrate its relative advantages from a statistical standpoint. As far as complete fracture is concerned, it is not claimed that favorable results might not be obtained by any other method if so applied as to accomplish its object, namely, apposition and fixation of the fragments. For this reason also I have not attempted to describe all the methods of treatment in present use, two of which at least, that of Thomas by efficient splinting and the combined lateral and direct traction advocated by Maxwell and Bardenheuer, present certain advantages over that which has been described as representative. On the other hand, the method of reducing the impacted fracture by abduction seems to me to be the only means by which the deformity may be corrected safely.

It has been my purpose to indicate certain principles of treatment sufficiently comprehensive to include all ages and local conditions and to describe methods of applying these principles effectively.

In the course of this argument I have attempted to justify the opening statement that fracture of the neck of the femur is a neglected subject, and in closing I may suggest that this injury would be far less disastrous in its results if the following conclusions were generally accepted:

1. Fracture of the neck of the femur occurs at any age, even in childhood.

2. An injury at the hip, followed by persistent disability, should always suggest fracture, and if one is not expert in the details of physical examination, an *x*-ray picture should be procured if possible.

3. As an impacted fracture must of itself cause disability, one should attempt to reduce it in the manner that has been described, provided efficient support can be assured.
4. The first essential in the treatment of complete fracure is to appose the fragments. For this purpose, direct traction under anæsthesia followed by fixation in the attitude of abduction seems to present certain advantages over the methods ordinarily employed.
5. If union has not followed routine treatment, the open operation is indicated in suitable cases.
6. Support and protection by properly adjusted apparatus is of great advantage during the period of repair, and in any event weight-bearing should not be permitted until the symptoms indicate that the consolidation is complete.
7. The distinction between the two forms of fracture that occur in young subjects is of importance as influencing treatment.
8. It seems probable that in the majority of cases treatment may be applied, tentatively at least, with advantage. The standard of success in treatment of the most favorable cases should be restoration of normal function, and in all one should at least attempt to apply the principles that are recognized as essential to success in the treatment of fractures in other situations.

ANATOMICAL INVESTIGATIONS BEARING ON DR. WHITMAN'S METHOD OF TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR.

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At Dr. Whitman's suggestion, dissections and observations were made upon a number of hips (eight). The joints were approached through a vertical incision between tensor vaginæ femoris and the glutei to the outer side, and the sartorius and rectus femoris muscles to the inner side. The capsule was split in the long axis of the femoral neck. The mechanical effects of the soft tissues therefore could not have been influenced.

The neck of the femur was divided transversely to its long axis. The level of division in the different cases varied from the junction of the head and neck to the junction of the neck and great trochanter. The difference between the qualities of living tissues and those of the cadaver should be remembered.

The following observations were made:

1. Before dissection the limit of abduction varied from 45 to 55 degrees from the median line.
2. When the neck of the femur was divided the outer fragment underwent a posterior displacement (downward as the subject lay

in the dorsal attitude) of ½ to 1 cm., combined with external rotation. In the cadaver there was no upward displacement such as occurs in the living.

3. Abduction to 45 degrees, combined with lifting forward of the outer fragment, produced and maintained good apposition between the fragments and gave the proper relation between the axis of the neck and that of the shaft of the femur. Abduction beyond 45 degrees caused separation of the fragments at the inferior border of the neck.

4. Abduction was limited by—

(*a*) The inferior ligaments and capsule.

(*b*) Impact of the posterior part of the great trochanter upon the soft tissues just above the acetabulum.

Both of these obstructions seemed to occur simultaneously.

5. The above observations held true regardless of the level at which the neck was divided.

6. The outer fragment of the neck caught under the rim of the acetabulum and cotyloid ligament only when the line of division was close to the head of the femur. The head of the femur fills the cavity made by cotyloid ligament and acetabulum.

7. Tension of the inferior capsule and its ligaments during abduction tended to cause spontaneous alignment of the fragments. This influence was more marked as the line of division of the neck approached the great trochanter.

8. Inasmuch as the fractured surfaces were rough, a slight amount of gentle rotatory manipulation combined with some lifting forward of the distal fragment (see observation 2) gave best apposition.

9. Division of the capsule and ligaments inferiorly rendered reduction more difficult, inasmuch as there was a tendency to upward displacement of the distal fragment during abduction and the usual spontaneous limitation of abduction was largely absent.

THE EARLY OPERATIVE TREATMENT OF HIP-JOINT DISEASE.[1]

WITH A REPORT OF TWO CASES.

By Thomas W. Huntington, M.D.,
of San Francisco, Cal.

This paper has as its basis the work done in connection with two cases of hip-joint disease, which have interested me greatly during the past eighteen months. This undertaking was inspired by the

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[1] Read before the California Northern District Medical Society, November, 1904.